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GROSS ANATOMY OF THE ALIMENTARY CANAL OF *ONCOPELTUS FASCIATUS* DALLAS (HETEROPTERA : LYGAEIDAE)

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An understanding of the general plan of the anatomy of the digestive system is a necessary prerequisite to the detailed study of the histological features of the various parts of the tract. The earliest work on the alimentary canal of Hemiptera was carried out by Dufour (1833), followed by Locy (1884) on the family Nepidae, Pantel and Licent (1910) and Licent (1912) on some Homoptera Auchenorrhyncha. One of the earliest investigations on small species of Homoptera was made by Lubbock (1858) on *Coccus hesperidium* (Coccidae), followed by Kershow (1910) on the candle fly *Pyrops candelaria.*

Feir (1974) in her review shows that very little work has been done on the alimentary canal and its physiology in*Oncopeltus fasciatus.* Apart from a brief study on the anatomy and histology of the digestive system of this insect provided by Hood (1937), some investigations on the physiology of its digestive organs were made by Bongers (1968, 1970). There is, therefore, reason to hope that further detailed work on the anatomy and histology of the midgut of *O. fasciatus* will provide a more reliable account of this terrestrial seed-sucking Heteroptera species.

MATERIALS AND METHODS

To study the general anatomy of the alimentary canal, freshly killed specimens of *Oncopeltus fasciatus* Dallas of both sexes were used (fifty specimens). For this purpose dissection was done in 70% alcohol, all illustrations and measurements were made under the dissection microscope with the aid of an eye piece graticule and micrometer.

OBSERVATIONS

The development of the mouth parts in *Oncopeltus fasciatus* has been traced by Butt (1949) and Newcomer (1948). Acording to Newcomer the mandibular lever in *Oncopeltus* is secreted by the wall of the mandibular setal sac after hatching, while the lever of the maxillary stylet is produced from a simple diverticulum of the maxillary setal sac.

The alimentary canal of *O. fasciatus* Dall. (Lygaeidae) is of a moderate length, about two and a half times that of the body, and divided as in other insects, into three major portions the stomodaeum or foregut, the midgut (mesenteron or ventriculus) and the hindgut or proctodaeum (Fig. I). *Stomodaeum* (*Foregut*) : The hypopharynx in Hemiptera is a well developed structure arising from the venter of all the gnathal segments (Heymons 1899). According to Newcomer the hypopharynx arises from the three gnathal and the intercalary segments in *Oncopeltus fasciatus* It forms the ventral floor of the

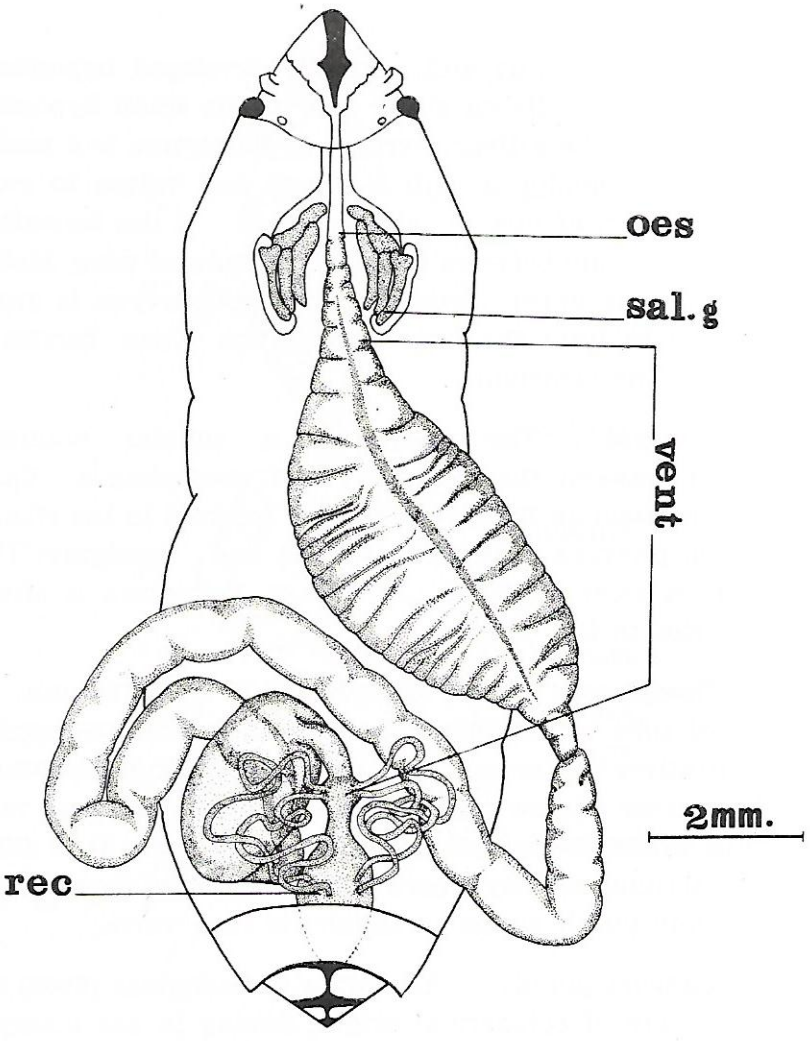

Fig. 1. Dorsal view of *Oncopeltus fasciatus* digestive system. oes=oesophagus, rec=rectum, sal. g=salivary gland, v=ventriculus.

food canal medially and a greatly developed hypopharyngeal wing laterally on either side of the small hypopharngeal lobe. The salivary syringe in Hemiptera is a modified salivarium, equipped with a piston and valves to control the direction of flow of salivary liquid. It lies beneath the food pump and between the hypopharyngeal wing, Matsuda (1965). The upper surface of the hypopharynx is grooved apically to form the floor of the tube which carries the food to the cibarium.

Pharynx : The pharynx is a tubular connecting region between the cibarium and oesophagus. Various authors such as Tower (1914) have referred to the cibarium as the pharynx, but Weber (1930) and Snodgrass (1935) made it clear that the pharynx of Hemiptera is situated posterior to the cibarium.

Oesophagus : The oesophagus is a short and thin walled tube which passes between the circum oesophageal connectives in the head and posteriorly into the prothorax. It is a very narrow region joining the enlarged first ventriculus where the oesophageal valve is located. It is difficult to determine exactly where this region ends from its gross anatomy but it seems to terminate in a valve.

Salivary glands : According to Snodgrass (1935) these glands are of ectodermal origin, arising in the embryo as paired invaginations just behind the bases of the rudiments of the second maxillary appendages. They are therefore treated here in connection with the stomodaeum.

In *O. faciatus* the salivary or libial gland consist of a pair of trilobed principal glands and a pair of tubular accessory glands with associated ducts. They lie on either

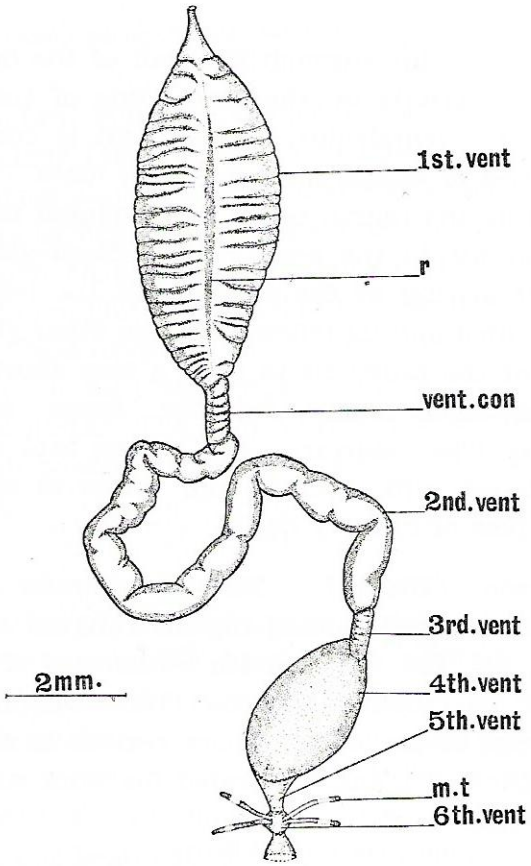

Fig. 2. Midgut of *Oncopeltus fasciatus*. m. t = malpighian tubules, v = ventriculus, ven. con = ventricular constriction.

side of a medium line through the wall of the oesophagus and extend posteriorly on the dorsal side of the anterior end of the first ventriculus. Each gland is composed of four parts, two of which form pyriform lobes. The third is bilobed while the fourth forms a convoluted tubule with its distal end within the head cavity. Each gland has a straight duct arising at the junction of the lobes of the gland. This duct and its fellow from the other gland unite at the base of the proboscis to form a very short common salivary duct which empties into the space below the hypopharynx. The salivary duct runs into a salivary syringe equipped with a piston and valves to control the direction of flow of salivary liquid.

Mesenteron (*Midgut*) : The mesenteron is differentiated into six well defined regions referred to here as the 1st, 2nd, 3rd, 4th, 5th, and 6th ventriculus (Fig. 2) and are described as follows. Glasgow (1914) was among the first to attempt to homologise these regions as they occur throughout the order and illustrated his work with a long series of figures.

1st ventriculus : This is a large thin walled sac-like structure, its size and shape depending very much on the amount of food or air it contains. It is capable of great distension, but it usually extends from the 1st thoracic segments to the 2nd abdominal segment. It was termed the crop by Malouf (1933) the "premier poche de ventricule chylifigue ou stomac" by Dufour (1833), the first stomch by Glasgow (1914), Wooley (1949),Harris (1938), Breakey (1936) and others. It has been called the first stomach of the ventriculus. The wall of the 1st ventriculus are transversely folded especially when empty, with median dorsal and

ventral raphes running almost the entire length of the region. Malouf (1938), states that both the oesophagus and crop have similar histological characters in *Nezara viridula*, and he belived that the terms stomach and ventriculus are erroneous, but Al-Saudouk (1977) supported the interpretation of Dufour and Glasgow. Malouf is apparently wrong in regarding the first ventriculus as the crop, the latter (which is an ectodermal structure) is always absent in the Hemiptera. The first ventriculus is usually distended by air bubbles which eliminate the folded appearance of its walls.

2nd ventriculus : The first ventriculus narrows posteriorly and passes into the 2nd ventriculus. This is a convoluted tube forming the longest part of the mesenteron. The junction between 1st and 2nd ventriculus lying at the posterior end of the 2nd abdominal segment. The 2nd ventriculus turns dorsally then anteriorly and ventrally with its anterior part under the 1st ventriculus. The region has been called the "first stomach" by Malouf, the "portion filiforme" by Dufour, the "intestine posterior" by Ancona and the second stomach of the ventriculus by Glosgow and other later workers. It is very light brownish white in colour and lies in the 2nd — 5th abdominal segment.

3rd ventriculus : The 2nd ventriculus joins the 3rd by a distinct constriction. This short white region is concealed between the convolution of the second ventriculus and lies in the third abdominal segment. It seems not to have been recognzed by Hood (1937), in his study of the alimentary canal of *O. fasciatus*.

4th ventriculus : The third ventriculus passes posteriorly into an ovoidal 4th ventriculus which is usually filled with food material. This organ is the "second stomach" of Malouf, the second "poche gastrique" of Dufour and the "third stomach" of Glasgow. It is dark brownish in colour and usually contains oil droplets when it is filled with food material. Miles (1958), has found that in mature nymphal stages, this part contained only a large droplet of oily materials.

5th ventriculus : The fourth ventriculus narrows posteriorly into a short narrow smooth walled tube called here the 4th ventriculus. This part is deviod of gastric caeca such as occur in many other Heteroptera, Glasgow (1914), Buchner (1953).

6th ventriculus : This is an elargment, considered here as the most posterior section of the midgut, into which the Malpighian tubules enter when they join the alimentary canal. Hood (1937), provisionally called it the pylorus in *O. fasciatus* but seemed boubtful.

This small part of the alimentary canal has been named by some authors working on Pentatomomorph species as the ileum or pylorus and considered as the most anterior segment of proctodaeum. It has been interpreted in this way not because of its histological features but because it received the opening of the Malpighian tubules. In this respect Snodgrass (1935), pointed out that in the majority of insects the Malpighian tubules arise from the proctodaeum. Henson (1932), however believes that the Malpighian tubules in some insects arise from the measenteron or from the undifferentiated zone between the endoderm and ectoderm. What was called the pylorous by Hood (1937) and treated as part of the proctodaeum, is

considered to be the most posterior part of the midgut and is termed the 6th ventriculus, Al-Sandouk (1977).

Proctodaeum (*Hindgut*) : The hindgut or proctodaeum of *O. fasciatus* is short and greatly reduced, being composed of only the rectum (Fig. 1). The latter commences at the ventriculo-rectal valve which is referred to by some workers as the pyloric or the ileo — rectal valve.

Goodchild (1965), claimed that in the Pentatomomorpha the pyloric region was enlarged to accommodate the opening of the Malpighian tubules, thus forming a distinct segment of the hindgut. This is not the case in *Oncopeltus* where the pylorus is histologically similar to the midgut in spite of the restricted opening of the Malpighian tubules, Al-Sandouk (1977).

The rectum is relatively large membranous structure which extends backwards to the posterior part of the last abdominal segment. It become narrow in the 6th abdominal segment and extends to the anus as a narrow tube with the exterior.

SUMMARY

The adult midgut of *Oncopeltus fasciatus* comprises six anatomically distinct ventriculi. The third ventriculus was newly recognized here and the sixth (previously called the pylorus) was shown in the present work to be the most posterior region of the midgut.

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Anatomy of **Oncopeltus fasciatus** alimentary canal

الخلاصـــة

حشرة ٠ تعـود الى رتبـة نصفية الاجنحة ومن *Oncopeltus fasciatus Dall.*
مجموعـة الحشرات التي تمتص عصارة البذور فهي مهمـة اقتصاديا جدا يكشف هذا البحـث ان القنـاة الهضميـة الوسطى التي تتعامل اساسا مع العضـارة المتصـة للبـذور تتألـف من ستة مناطق مميـزة كما جـاء في البحـث وليـس من اربعة مناطـق كما اعتقـد العالـم C. W. Hood فـي سنـة ١٩٣٧ ٠٠